Can You Imagine . . .

. . . a calibration-free thermometer that may help fossil-fuel power plants protect boiler tubes and other costly equipment from overheating.

THE COMMERCIALIZATION OF THE JOHNSON NOISE THERMOMETER IS CURRENTLY IN NEGOTIATIONS.

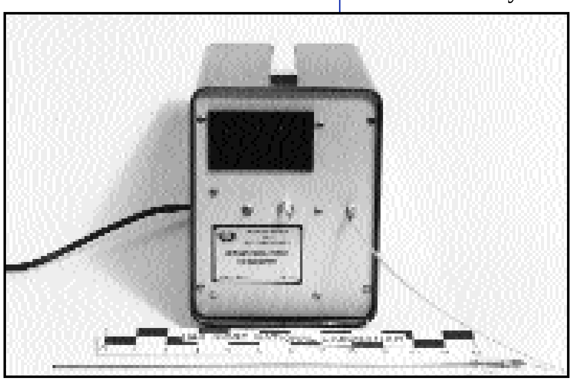
NEW SENSOR TAKES THE HEAT IN UTILITY APPLICATIONS

Sensors are perhaps some of the oldest equipment in today's fossil-fuel power plants. As a result, they do not accurately provide the data required for either efficient plant operation or early detection of equipment failure. In power plant boiler tubes, for example, the reliability of resistance temperature detectors (RTDs) decreases when steam temperatures rise above 500˚C. At these temperatures, boiler tubes may explode, requiring costly repairs and plant downtime.

To prevent boiler tubes from overheating, plant personnel need a better way to verify RTD temperature readings. In cooperation with the Electric Power Research Institute (EPRI; Palo Alto, CA), researchers at Oak Ridge National Laboratory (ORNL; Oak Ridge, TN) developed a simple device called the Johnson Noise Thermometer (JNT). Originally developed to monitor coolant temperatures up to 1,100˚C, the JNT was intended for use on a space-based nuclear reactor jointly funded by BMDO, NASA, and the U.S. Department of Energy.

The JNT can measure temperatures up to 1,100˚C over long periods with an accuracy of about 1 percent. Because the JNT can maintain this level of accuracy indefinitely, it eliminates the need for expensive recalibration or replacement of conventional thermometers. Other thermometers, susceptible to drift, provide less accurate temperature measurements at high temperatures.

The JNT's accuracy over long periods at high temperatures makes it attractive for verifying the accuracy of RTDs in fossil-fuel and nuclear power plants. To demonstrate this technology, ORNL tested several JNT prototypes at the Tennessee Valley Authority's Kingston steam plant. In these tests, the devices successfully identified when existing RTDs drifted.



■ Pictured above is an industrial prototype of the JNT. In a demonstration at a fossil-fuel utility plant, this device monitored furnace temperature.

EPRI, which funded the tests, is negotiating the commercialization of JNT technology, but must still address shielding material and packaging requirements, among other issues. It has already found one utility to support this research and continues to look for others.

Power plants could also use the JNT to generate power more cost-effectively. Higher temperatures and pressures increase the efficiency of a plant's turbines, and the JNT can help plant personnel monitor such temperatures. Other uses for the technology may include unattended temperature recording and monitoring, as well as controlling chemical, ceramic, metallurgy, and petroleum processes.

ABOUT THE TECHNOLOGY

The JNT operates on the principle that any electrical conductor (metal, semiconductor, or resistor) produces random electrical signal oscillations because of thermal vibrations in the material structure. For alternating current signals in the 10 kHz range and higher, Johnson noise predominates as the internally generated noise component, varying proportionally with the total resistance of the circuit element and its temperature. Therefore, temperature measurement is possible as long as the resistance is known. Unlike other RTDs, however, the JNT does not require the relationship between temperature and resistance, because it works regardless of the material. It is particularly attractive for applications where long-term stability and calibration-free operation are critical.